

Low energy domestic lighting

– A summary guide



2002 EDITION



**HOUSING
ENERGY EFFICIENCY**

BEST PRACTICE
PROGRAMME

INTRODUCTION

INTRODUCTION

Lighting design and specification, whether using tungsten or fluorescent bulbs (**lamps**), has a major impact on the appearance, ‘feel’ and usefulness of a room. Specified and installed correctly it can provide a pleasant and useful environment for carrying out a range of activities. Poor lighting however can be bland, make tasks difficult to carry out, and is disliked by occupants. There are many factors influencing the impact and efficiency of lighting and this leaflet is intended to help designers, builders, and installers avoid common problems and improve both the quality of domestic lighting and energy efficiency.

The leaflet is mainly concerned with tubular fluorescent lamps and compact fluorescent lamps (CFLs) with separate ballasts ie pin based lamps, but many of the issues are relevant to CFLs with integral ballasts. Pin based lamps cannot be replaced with ‘standard’ **general lighting service** (GLS) incandescent lamps. This makes them preferable in situations where continued energy efficiency is required. CFLs with integral ballasts are ideal for replacing GLS lamps in existing fittings (**luminaires**).

GENERAL LIGHTING DESIGN

The foundation of good lighting is the overall lighting design. Basic light sources such as central pendent lamps which attempt to provide lighting for all purposes including reading, dining, watching television, and entertaining will generally result in a bland appearance and low occupant satisfaction. Good lighting provides a mixture of light and shade so permanently installed lighting should be designed to provide enough **background lighting** for general movement, and should be supplemented by an occupant’s own **task** and **accent** lighting. This allows luminaires and lamps to be selected to provide the desired lighting effect for a specific purpose.

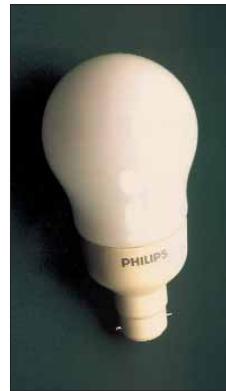
WHY IS LOW ENERGY LIGHTING IMPORTANT?

Improving the efficiency of lighting has always been important but with higher insulation levels and increased heating system efficiencies the energy used for lighting is increasing as a proportion of the total household energy usage. In new low energy houses lights and appliances can account for 20% of the total energy use, 33% of the resulting CO₂ emissions, and 75% of the fuel costs. Appliances are generally outside of the control of the designer and builder but significant savings can be made through improving lighting design and efficiency.

Pin based CFL – requires separate ballast



CFLs with integral ballast



Photos supplied by Philips Lighting

ENERGY-EFFICIENT LIGHTING

WHAT IS ENERGY-EFFICIENT LIGHTING?

There are many factors which affect the overall efficiency and effectiveness of lighting including the compatibility of the luminaire and the lamp (see 'selecting lamps') as well as the general lighting design. However for the purpose of this leaflet 'energy-efficient' is where the lamp has a **luminous efficacy** of at least 40 lumens/circuit watt. 'Circuit-watts' means the power consumed in the lighting circuit by lamps and their associated control gear. Compact and tubular fluorescent both meet this criteria whereas incandescent lamps

such as tungsten filament and tungsten halogen lamps do not (figure 1).

SELECTING SUITABLE ROOMS

Most rooms can benefit from energy efficient lighting but the greatest savings will be made in rooms that are lit for the longest periods. Additionally, the life of most types of lamps is influenced by the frequency with which they are switched on and off. This is particularly true of fluorescent lighting and is another reason for installing it in rooms that are lit for longest. The most lit rooms will vary with house layout and with occupant lifestyle, but an Energy Efficiency Best Practice programme study of 39 households^[1] showed that the rooms lit for the longest periods were the hall, lounge and landing (figure 2).

SELECTING LAMPS

In the same way that there are different options for GLS lamps (eg clear, pearl, tinted), there is also a range of options for fluorescent lamps that can have a significant impact on lighting appearance. These include colour rendering, colour temperature and lamp output.

Colour rendering

Colour rendering is a measure of the appearance accuracy of different coloured surfaces under different lamps and a **Colour Rendering Index** (Ra) is used to compare lamps. Most fluorescent lamps are classified as either 'excellent' (Ra 90 – 100) or 'good' (Ra 80 – 89). An Ra greater than 80 is suitable for all domestic situations and wherever accurate colour judgements are necessary.

Colour temperature

The 'warmth' or 'coolness' of a lamp is indicated by its colour temperature, the lower the **colour temperature** the 'warmer' the appearance of the light. Early fluorescent lamps had a very cold appearance but a wide range of temperatures is now available. Lamps of different temperatures should not usually be mixed within a room unless a specific effect is required.

Figure 1
*Luminous efficacy
of a range of lamp types*

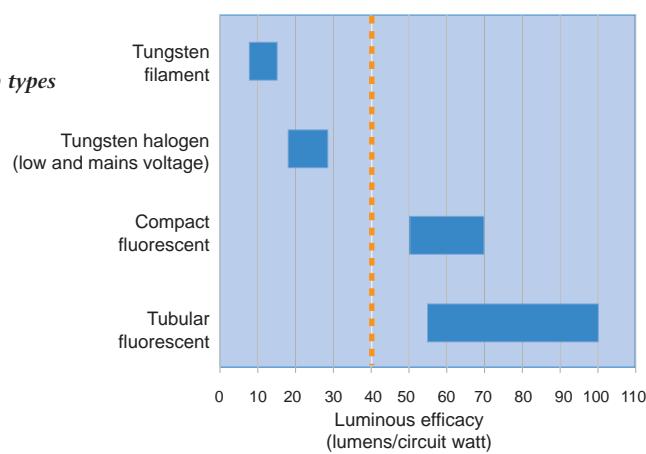
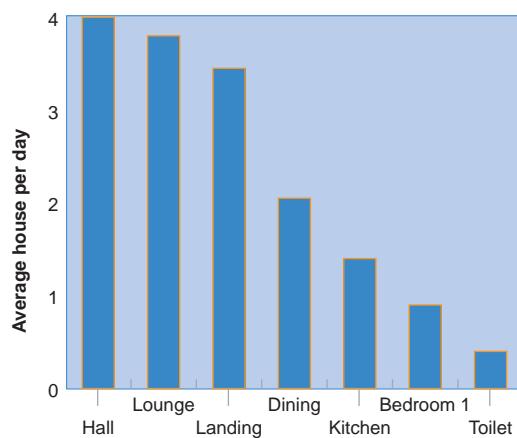


Figure 2
*Average hours of lighting
in different locations*



LAMP BALLASTS

Generally fluorescent lamps between 2700K and 3000K will be suitable for domestic situations except in rooms where the electric light complements daylight when a cooler temperature of around 4000K may be desirable. The range of lamp temperatures is shown in figure 3.

Lamp output

When selecting lamps it may not be appropriate to simply choose a CFL with equivalent **lumen** output to a given incandescent lamp. Although output may be identical, the distribution (or direction) of the light for the two lamps will be different and they will not produce the same lighting effect. Light output from all lamps including CFLs also decreases with age. It may be that a higher wattage CFL and compatible ballast should therefore be specified if there is any doubt.

Manufacturers generally state the colour rendering and temperature of a lamp using three-digit **colour reference number** eg 827. The first number (8) indicates the initial number of the colour rendering index and the second two numbers (27) indicate the initial numbers of the colour temperature (figure 4). The colour reference number is often preceded by the lamp wattage in manufacturers' literature.

LAMP BALLASTS

All fluorescent lamps require **ballasts** or 'control gear'. These may be conventional wire wound ballasts or full electronic ballasts. Most integral ballast CFLs use electronic ballasts but most luminaires designed for pin-based CFLs are preassembled and could use wire wound ballasts unless requested otherwise.

Electronic ballasts have many benefits over wire wound ballasts and should be specified wherever possible. These benefits include:

- Almost instant start up without flashing
- Longer lamp life
- No flicker in use
- Silent operation

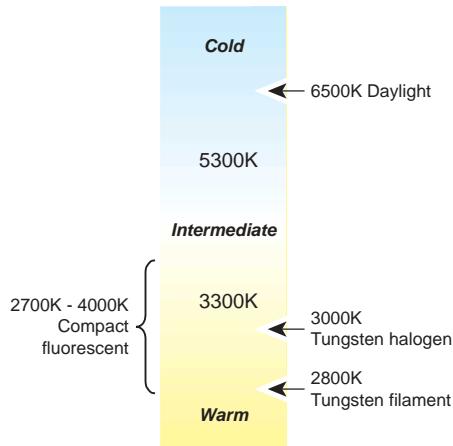


Figure 3
Colour temperature of different lamps

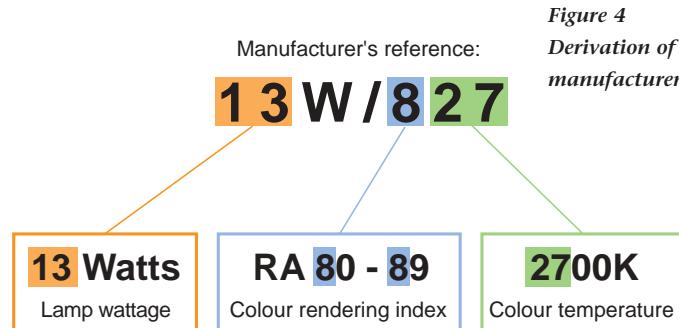


Figure 4
Derivation of manufacturer reference code

- Dimming possible (with all 4 pin lamps and specialist control gear – NOT conventional mains dimmers)
- Automatic switch off at the end of lamp life eliminating any lamp flashing

SUMMARY

It can be seen that lighting with fluorescent lamps does require some special considerations but when carefully considered and combined with good lighting design it can produce lighting that is both attractive and energy efficient.

EXTERNAL LIGHTING

EXTERNAL LIGHTING

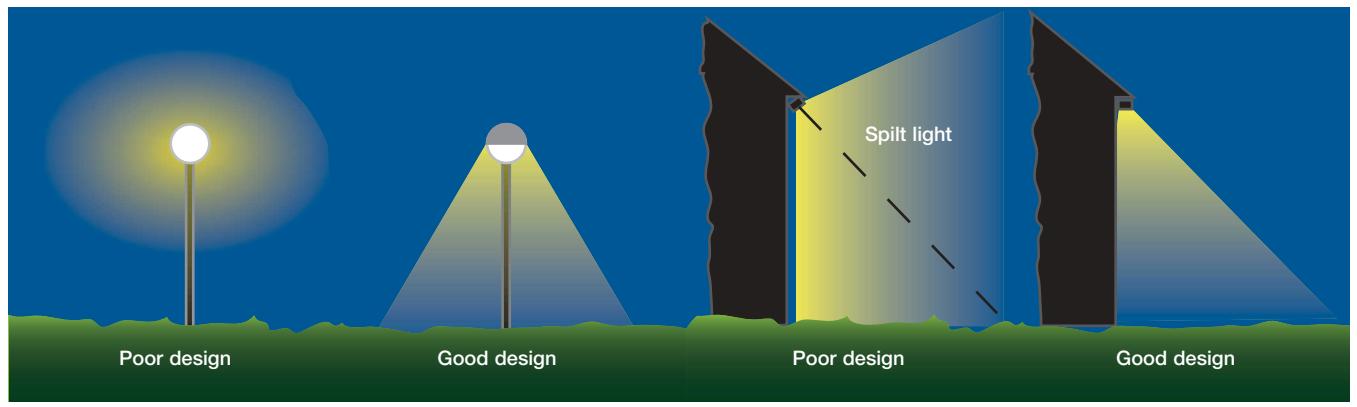
The approach to energy efficient external lighting depends on its function. Where lighting is only required for short periods – when an area is passed through – the best approach is to use a conventional incandescent lamp combined with controls. Use controls that will automatically turn off the lamp when there is enough daylight *and* when not required at night. A photocell combined with a passive infrared (PIR) detector will achieve this.

Where lighting is required at night for extended periods luminaires which only accept pin based fluorescent lamps should generally be used. Ideally

even fluorescent lamps should be controlled to prevent use when not required. This could include the use of photocells and timers although care needs to be taken to ensure that these controls are suitable for use with CFLs. PIRs can be used with CFLs for most external domestic situations but should be avoided where frequent switching may occur eg a communal entrance hall to flats. In some situations with very long lighting periods high-pressure discharge lights can be used. These have a higher luminous efficacy than fluorescent lamps but a lower colour rendering index.

Light pollution and glare

External lighting that is badly selected and installed can result in light being directed into the sky. Not only is this wasteful in energy terms it also ‘pollutes’ the view of the sky. If lighting is misdirected it can also cause discomfort and visual impairment - possibly resulting in accidents.



FURTHER INFORMATION

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Housing Energy Efficiency Best Practice programme

- ADH 001 Domestic Lighting Innovations
- GPCS 361 Energy-efficient lighting for housing
 - exemplars for builders; installers; owners and managers
- GPG 199 Energy efficient lighting – a guide for installers

Housing Energy Efficiency Best Practice programme publications are available from www.housingenergy.org.uk or 01923 664258.

Action Energy

- GPG 300 The installer's guide to lighting design
- ECA 3 Installer's lighting guide number 3
 - Exterior lighting for small premises
- ECA 4 Installer's lighting guide number 4
 - Lighting requirements for Part L of the Building Regulations England and Wales

Action energy publications are available from www.actionenergy.org.uk or 0800 585794.

Reference

- 1 GIL 20 Low-energy domestic lighting (1994 edition)

Other publications

- Dwellings and energy efficient lighting: new regulation Part L, BRE IP5/02, BRE
- www.brebookshop.com
- Tel 01923 664262

Relevant organisations and websites

The Lighting Association

- www.lightingassociation.com
- Tel 01952 290905

The Lighting Industry Federation

- www.lif.co.uk

The Government's Housing Energy Efficiency Best Practice programme provides impartial, authoritative information on energy efficiency techniques and technologies in housing. This information is disseminated through publications, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Visit the website at www.housingenergy.org.uk

Call the Housing Helpline on **01923 664258**

Energy Consumption Guides: compare energy use in specific building types.

Good Practice: promotes proven energy-efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R&D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

The Housing Energy Efficiency Best Practice programme is managed by the Energy Saving Trust (EST).

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